The biomechanical demands placed on the canine forelimbs are considerable and complex. Diagnosis of forelimb lameness is often challenging, requiring a systematic and anatomically detailed approach. This discussion focuses on methods and diagnostics to improve your forelimb evaluation.

Gait observation plays an essential role in improving your capability, accuracy, and efficiency of forelimb localization. Weight distribution between limbs is altered with weight shifting to unload painful limbs. Postural changes provide clues to localization. For example, cervical ventroflexion is suggestive of cervical disease, whereas cervical extension suggests caudal weight shifting, as commonly noted in patients with bilateral elbow pain.

Abnormal forelimb motion is a tipoff for several conditions. Incomplete elbow extension suggests elbow disease, for instance, and limb circumduction suggests infraspinatus muscle contracture. Head carriage, joint extension, limb alignment, foot contact patterns, and limb motion pathways are visual clues to better understanding of mobility and function.

A cursory standing orthopedic evaluation performed in combination with gait evaluation may be your stepping stone to discovering the cause of lameness in more difficult cases. Use palpation to detect pain and anatomic abnormality and magnify symptoms. This opens doors to more specific and confident localization and ultimately the underlying diagnosis. The cursory standing examination provides for a quick assessment that is adaptable, and can quickly be expanded into a more in-depth evaluation, including a neurologic examination combining flexibility with a thorough, systematic approach. In the forelimb presentation, this includes muscle symmetry palpation, cervical flexion and palpation, joint flexion and extension, and palpation of the joint capsule, major muscle groups, and long bones. More specific goals will be addressed as we progress.

Oddly, injuries to phalanges may produce a non-weight-bearing lameness, especially when involving the pads. We like to think of dogs as having their own “four-toe drive.” Phalangial injuries will often change the tracking or foot-strike pattern to adaptively protect the injured digit. This is evident in the patient’s gait or footprint. Pay special attention to toe placement and posture during standing. A useful aid in assessing weight-bearing is determining if the phalanges of the foot spread out equally as compared between legs. Evaluating nail wear patterns helps in characterizing chronic abnormal foot tracking patterns.

The lower forelimb is very animated in motion, and the carpus is very dynamic, with more flexion and extension than any other set of joints. Essentially, the carpus consists of multiple small bones supported by an array of short ligaments that are linked like a chain. Each of these individual ligaments is stretched under weight-bearing forces into hyperextension, like a spring that, as released, produces dynamic motion. The dorsal surface undergoes compression over articular surfaces, and the palmar surface is subjected to tensional forces supported by ligaments. Injuries will typically follow biomechanical stress patterns, with tensional injuries, such as ligament tears, or avulsion fractures on the palmar surface being the most prevalent and occurring at any level. Loss of supportive structures produces observable collapse under weight-bearing, with a change in standing angle (normal carpal standing angle is 7 to 15 degrees of extension). There is also a loss of carpal animation or a loss of the “spring in the step” even with less severe injuries. Although complex, carpal structures are distinctly palpable. Swelling, instability, joint effusion, and periarticular thickening are typically discernable on palpation. Palpate the carpal joints and digits for detection of asymmetry between bony prominences, periarticular thickening, or joint effusion. Palpate the contralateral limb for comparison in anatomy, range of motion, and sensitivity. Use flexion and extension of the carpus to provide better access to articular surfaces and individual ligaments. Firm, generalized thickening with a loss of flexion often indicates degenerative joint disease, indicating prior instability and inflammation. Raising each foot in succession maximizes weight-bearing on the standing foot, providing an unprotected assessment of the functional stability of the carpus. Carpal radiographs assess at least 14 individual, overlapping bones with multiple articular surfaces (more if you include phalanges), so I take advantage of flexed views and stressed views to determine specific instability and displacement.

Forelimb length is most influenced by the elbow; thus, abnormalities of the elbow motion produce significant gait alterations. As testimony to this, elbow arthrodesis produces dramatic gait changes as compared to carpal or shoulder fusion. Evaluation of the elbow should include palpation of the elbow joints for asymmetry between bony prominences, periarticular thickening, or joint effusion. Firm, generalized swelling often indicates degenerative joint disease.
Bicipital injuries can affect the shoulder or the elbow as it crosses both joints. The distal insertion of the biceps tendon on both the radius and ulna may have more significant impact than previously realized through its insertion strength, followed by healing. Certain muscle-tendon complexes are more predisposed to injury due to anatomic muscle fibers, followed by pronounced inflammation in the following days that greatly degrades muscle contraction humans consist of muscle injuries, so I try not to discount their significance. Strain injury results in disruption of angles that typically requires sedation to thoroughly evaluate. It is essential to have the shoulder in full extension ligaments and surrounding musculature. Severe disruptions produce subluxation with overt increased abduction more commonly noted with shoulder instability. Stability of the shoulder relies on the collateral glenohumeral ligament and subjected to stress from two joints. In addition, mineralization within the overlying subchondral bone. My ability to diagnose this condition and incorporate the use of radiographs in this diagnosis improved with my understanding of this concept. Particularly in the early stages of elbow disease, radiographic evidence of bone changes associated with a disease process may be minimal or absent despite clinical symptoms and positive arthroscopic findings. One recent study reported 16 elbows with confirmed coronoid pathology and no radiographic signs (median duration of clinical signs 15.6 months and median age 30 months). Traditionally, radiographic signs consistent with elbow dysplasia include indistinct medial coronoid process, osteophytosis of the anconeal process and the medial joint space. In recent studies, pericoronoid regional sclerosis has become valuable in detection of coronoid disease. The percent of radiographic sclerosis is correlated with confirmed disease, averaging 47% in diseased elbows and 0% in nondiseased elbows, providing a fast, reliable, and simple evaluation method (Smith et al. 2009). As degenerative joint disease advances, effusion and osteophytosis will become more evident involving the radial head, caudodistal humerus, and proximal ulna. Although traditionally considered as part of the syndrome of elbow dysplasia, OCD does not appear to be as prevalent or closely associated as once believed.

Differentiating between elbow and shoulder lameness can be challenging and often requires diagnostic evaluation of both joints. In a recent study, diagnostic localization between the elbow and shoulder was found to be 80% accurate, with 25% of the cases showing abnormalities at both joints (Cook and Cook 2009). The most clinically relevant orthopedic examination findings were spinatus muscle atrophy, shoulder abduction angles, elbow effusion, and radiographic findings. More than 25 muscles contribute to the motion of the shoulder, and yet altering the function of a single muscle can severely alter the motion of the shoulder. Ninety-five percent of orthopedic presentations in humans consist of muscle injuries, so I try not to discount their significance. Strain injury results in disruption of muscle fibers, followed by pronounced inflammation in the following days that greatly degrades muscle contraction strength, followed by healing. Certain muscle-tendon complexes are more predisposed to injury due to anatomic factors with more significant clinical impact.

Bicipital injuries can affect the shoulder or the elbow as it crosses both joints. The distal insertion of the biceps tendon on both the radius and ulna may have more significant impact than previously realized through its insertion near the medial coronoid process. The biceps tendon is constrained within the intertubercular groove and transverse humeral ligament and subjected to stress from two joints. In addition, mineralization within the overlying supraspinatus muscle (myositis ossificans) can produce impingement and pain. Localization in this region can be quite complex. Evaluation of one particular shoulder stress test in which the shoulder is flexed and the elbow is extended was once believed to be pathognomonic for bicipital injuries. It has since been found in multiple studies to be more commonly noted with shoulder instability. Stability of the shoulder relies on the collateral glenohumeral ligaments and surrounding musculature. Severe disruptions produce subluxation with overt increased abduction angles that typically requires sedation to thoroughly evaluate. It is essential to have the shoulder in full extension when measuring shoulder abduction angles (normal shoulder abduction is less than 30 degrees). Like the elbow, many of shoulder conditions have minimal radiographic changes, and arthroscopic examination may be required to
diagnose specific joint conditions of the biceps tendon, subscapularis tendon, and medial glenohumeral ligament (MGL). An additional aid to shoulder localization is intra-articular injection of Depo-medrol (20–40 mg), which can provide temporary improvement (~3–6 weeks) in many patients while confirming your localization.

Based on the results of the orthopedic examination, abduction angle tests, and arthroscopic scoring, patients are placed into one of three treatment categories: mild, moderate, or severe. For patients with abduction angles of 30° to 45° and arthroscopic findings consisting of mild pathology (inflammation without fraying, disruption, or laxity of the MGL, subscapularis tendon, joint capsule), patients are placed in a shoulder support system or hobbles (see Doglegs.com) and entered into a rehabilitation therapy program.

Dogs with moderate pathology (moderate category) typically have abduction angles that range from 45° to 65° and arthroscopic findings consisting of fraying, disruption, and laxity of the subscapularis tendon, medial glenohumeral ligament, focal synovial proliferation associated with the subscapularis tendon, and synovial hypertrophy or hyperplasia. Additional findings may occasionally include a bulge of the supraspinatus tendon with biceps impingement. Dogs in this category are typically treated arthroscopically with radiofrequency (RF) treatment and/or imbrication, or tightrope stabilization. Dogs are placed in hobbles for 12 weeks and entered into a rehabilitation therapy program.

Dogs with severe medial shoulder instability (MSI) typically have shoulder abduction angles greater than 65°. Arthroscopic findings usually include complete tears of the medial glenohumeral ligament and severe disruption of the subscapularis tendon and joint capsule. For this type of injury, reconstruction of the medial compartment by direct tissue reapposition and synthetic capsulorrhaphy by a medial approach or TightRope stabilization may be indicated. Following surgical repair, dogs may be placed in a custom non-weight-bearing velpeau sling for 1 or 2 weeks, followed by the shoulder support system (hobbles) for 3 months. Rehabilitation therapy is required for a longer period of time, as recovery following primary reconstruction ranges from 4 to 6 months. Fortunately, severe cases are less common and are usually due to trauma rather than repetitive activities, as seen in the mild and moderate categories.

Appropriate postoperative care is a critical factor in dogs with MSI. Physical therapy for orthopedic conditions has a strong scientific background in human medicine. Many studies have shown the benefits of rehabilitation following rotator cuff surgery. The canine rehabilitation therapist should be aware of and apply what is known to be effective in human practice. Many of the same goals, strategies, and techniques will be applied in the following rehabilitation protocol. It should also be noted that this protocol is given as a guideline to rehabilitation; regular monitoring of the exercise program and its progression is necessary for full benefit. Be aware that not all exercises work for every patient, and that some exercises will require trial and error to achieve desired results.

On the lateral aspect of the shoulder, collateral injuries appear to be less common, but several large muscle groups affect shoulder motion, including the supraspinatus, infraspinatus, deltoid, and teres minor muscles. Of these, the infraspinatus has the most significant and interesting clinical impact. The infraspinatus muscle originates from the scapula, and it is constrained cranially by the spine of the scapula before insertion on the humerus. This osseous constraint appears to subject this musculotendinous complex to greater stress, resulting in significant fibrosis and producing functional shortening with palpable atrophy. This single muscle contracture externally rotates the humerus, tethering shoulder motion and producing a circumducting gait. Lameness is often surprisingly acute, typically affecting medium and large, active, middle-aged dogs. Examination reveals limited shoulder extension with atrophy of the infraspinatus. My favorite clinical trick is to flex the elbow to 90 degrees and internally rotate the limb. Dogs with infraspinatus contracture will have extremely limited internal rotation. Surgical release of the infraspinatus tendon and associated fibrosis restores a nearly normal gait, which shows the resilience and adaptability of these systems.

Finally, it is also important to palpate the caudal compartment of the shoulder for pain (frequently osteochondrosis dessicans, panostitis, and septic arthritis in adolescent patients, and osteosarcoma and caudal glenoid fragmentation in middle aged and older dogs). Again, this demonstrates the importance of signalment in providing insight into the most common diagnosis. Axillary pain coupled with limb pain should direct us toward disorders of the brachial plexus, including trauma, nerve sheath tumors, and cervical disk disease. Hence, forelimb diagnostics are never complete without thorough cervical evaluation. This should include vertebral palpation, epaxial muscle palpation, axillary palpation, and neck flexion and extension in all directions.
We end with these observations. Patients with Wobber’s syndrome (caudocervical spondylomyelopathy) often will have postural changes with ventroflexion of the neck, a base-wide stance with hindlimb ataxia, and forelimb hyperpathia. Smaller dogs with Type 1 disk extrusion commonly have severe cervical pain and ventroflexion of the neck and do not want to move. Patients with a brachiplexus tumor present with unilateral symptoms, muscle atrophy, and, not uncommonly, Horner’s syndrome (ptosis, enopthalmus, miosis). This systematic diagnostic approach will help you differentiate between these complex presentations.

References
Veterinary Surgery 2009;38(2). Issue dedicated to advances in canine elbow disease.